

SAR Polarimetry Workstation

SAR POLARIMETRY WORKSTATION

The PCI Geomatics SAR Polarimetry Workstation provides a complete set of tools and applications designed specifically for the processing and analysis of Polarimetric SAR (POLARSAR) data.

The SAR Polarimetry Workstation can:

- Assimilate a variety of POLARSAR data products in their original distribution formats.
- Map product-specific metadata to a set of standardized metadata items.
- Provide multiple modes of manual target selection.
- Provide a comprehensive set of target analysis operations with both numerical and graphical output.
- Provide a comprehensive set of operations on entire datasets.

MODULE PREREQUISITES

The SAR Polarimetry Workstation is an add-on to Geomatica Core.

POLSAR DATA SUPPORT

The following POLARSAR data products can be read from their original distribution formats:

ENVISAT ASAR

- Single-look complex (APS/SLC)
- Precision (APP)
- Ellipsoid geocoded (APG)
- Medium resolution (APM)

Cosmo-SKYMED

- Level 1A SCS (Single-look complex slant range)
- Level 1B DGM (Detected Ground Multi-look)
- Level 1C/1D Geocoded GEC and GTC

ALOS PALSAR

- JAXA Level 1.1 Dual Polarization
- JAXA Level 1.1 Quad Polarization

RADARSAT-2

- SLC (Single-look complex)
- SGF (SAR Georeferenced Fine)
- SGC (SAR Georeferenced Coarse)
- SGX (SAR Georeferenced Extra-fine)
- SSG (SAR System Geocorrected)
- SPG (SAR Precision Geocorrected)

TerraSAR-X

Level 1b products including:

- SSC (Single-look, slant range complex)
- MGD (Multi-look ground range detected)
- GEC (Geocoded ellipsoid corrected)
- EEC (Enhanced ellipsoid corrected)

AIRSAR

- Multi-look complex (MLC)

SIR-C

- Single-look complex (SLC)
- Multi-look complex (MLC)
- Multi-look detected (MLD)

SIR-C

- Single-look complex (SLC)

METADATA SUPPORT

Metadata support is crucial to the processing and analysis of POLARSAR data. The SAR Polarimetry Workstation reads metadata from POLARSAR data products and transforms them to the following standardized metadata items:

File-level metadata items:

- Sensor Model Name
- Sensor Type
- Product Type
- Acquisition Type
- Matrix Type
- SAR Calibration
- Microwave Band

Band-level metadata items:

- Matrix Element

Technical Specifications

Most analysis operations on POLSAR data regard such data as a raster of matrices, rather than simply a multi-band raster. The matrices may be of different types: scattering (complete and incomplete), covariance (complete and incomplete), coherency, and Kennaugh. The metadata read by the SAR Polarimetry Workstation includes items that identify the matrix type and map dataset bands to matrix elements.

TARGET SELECTION AND ANALYSIS

The SAR Polarimetry Workstation provides three modes of manual target selection that support a comprehensive set of target analysis operations and allows targets of any size and shape to be selected.

SQUARE NEIGHBORHOOD

- Defines a target as a square neighborhood centered on a user-selected pixel.
- The neighborhood dimension can be user-specified.
- The neighborhood can be as small as a single pixel.

ARBITRARY REGION

- Defines a target as the region enclosed by a user-digitized polygon.
- A rectangle sub-option allows you to quickly digitize exact rectangular polygons.

PIXEL PLUS CLUTTER ESTIMATION REGION

- Defines a target as a user-selected pixel plus four nearby square regions that are used for estimating clutter.
- The user-specified neighborhood is the size of the square that encloses the overall target.
- The user-specified gap size is the space between the clutter-estimation regions.

TARGET ANALYSIS – NUMERICAL OUTPUT

The following target analysis operations that produce numeric (text) output are available:

- Scattering matrix
- Covariance matrix
- Coherency matrix
- Kennaugh matrix
- Correlation coefficient
- Pedestal height
- Total power
- Intensity ratio
- Coefficient of variation
- Fractional polarization
- Polarimetric discriminators
- Pauli component
- Phase difference
- Freeman-durden parameters
- Van zyl classification
- Cloude-pottier parameters
- Huynen parameters
- Cameron parameters

The output from these operations is written to the Numerical Output window.

Functionality includes:

- Numerical output automatically regenerated when a new target is selected.
- Contents of numerical output window can be exported to a file.
- Clear contents of numerical output window at any time

TARGET ANALYSIS – GRAPHICAL OUTPUT

The following target analysis operations that produce graphical output are available:

- Polarization response plot (co-polarized and cross-polarized); the plot can be interactively rotated.
- Histogram plot of selected parameters derived from matrix elements for extended targets.
- 2-D and 3-D scatterplot of selected parameters are derived from matrix

Technical Specifications

elements for extended targets. 3-D scatterplots can be interactively rotated.

Output graphs can be exported to the following formats:

- Postscript
- PNG
- GIF

APPLICATION PROGRAMS

SAR Polarimetry Workstation programs can be run in scripting (EASI) or GUI/visual modeling (Focus Algorithm Librarian, Modeler) environments.

The following programs are included:

- PSINGEST – converts a POLSAR distribution-format data set into a PCIDSK file.
- PSLTD – utility program to convert linear scaled data (such as intensity bands) to decibel scaling, for visualization and comparison.
- PSTOTPOW – Computes the total power of a given polarimetric SAR dataset.
- PSINTRAT – computes the intensity ratio between two polarizations.
- PSPHDIFF – computes the phase difference between two polarizations.
- PSCC – compute the complex correlation coefficient between two channels for single look complex data, and computes the real correlation coefficient for multi-look data.
- PSPOLDIS – decomposes a polarimetric SAR image into several common discriminators based on the extrema of polarimetric response.
- PSEABA – decomposes a polarimetric SAR image into entropy, α -angle, β -angle, and anisotropy components.
- PSPEDHT – Compute the minimum polarimetric response image of a fully-polarized polarimetric SAR image.
- PSVANZYL – determine the van Zyl classes for the entire image of a fully-polarized polarimetric SAR image.
- PSFREDUR – determine the Freeman-Durden scattering classes for a polarimetric SAR image: rough-surface scattering, double-bounce scattering, and volume scattering contributions.
- PSPOLSYN – compute the response across an entire fully-polarized SAR image given an arbitrary transmit and receive polarization.
- PSPOLSYNC – compute the polarimetric response across an entire fully-polarized SAR image maximizing the contrast between two targets.
- PSPOLYSYNR – compute the polarimetric response across an entire fully-polarized SAR image that maximizes the response of targets specified by the user.
- PSPOLFIL – performs a modified Lee speckle filtering across an entire fully-polarized SAR image.
- PSWHITE – determines the location of strong targets of interest in a fully-polarized SAR image, and computes the probability of a false target.
- PSCLOPOT – performs an unsupervised Cloude-Pottier classification of a fully-polarized polarimetric SAR dataset, assigning pixels to pre-determined classes.
- PSSWIS – performs a supervised Wishart classification of a fully-polarized SAR dataset, assigning each pixel to a class based on the distance from the targets specified by the user.
- PSUSWIS – performs an unsupervised Freeman-Durden or Cloude and Pottier classification results (see PSFREDUR or PSCLOPOT) and assigns a pixel, based on those results, to an integer class based on the number of standard deviations from the mean of a given class.
- PSSSCM – perform a symmetric scattering characterization method decomposition, providing structural information about symmetric targets on the ground on fully-polarized datasets.
- PSBOXCAR – average a polarimetric SAR dataset to increase the equivalent number of looks per pixel using a simple spatial mean filter.

Technical Specifications

- PSINANG – convert orbital and positional information from the data provider's metadata into an incident angle map that covers an entire scene.
- PSCREATE – creates a PCIDSK file that is set up for POLSAR data storage.
- PSTOUZIDEC – perform the Touzi Decomposition on a fully-polarized SAR dataset, providing the Touzi α -angle, the helicity and the Touzi phase of a given target.
- PSTOUZIDIS – Compute the Touzi Anisotropy and the minima and maxima of polarimetric response across an entire image.

CUSTOMIZATION

The SAR Polarimetry ProPack lets you create customized POLSAR processing algorithms and procedures. Customized algorithms and procedures can be run alone or incorporated into the target analysis workflow.

Three types of functions are included in the SAR Polarimetry ProPack:

- 'File-based' functions that process entire datasets
- 'Buffer-based' functions that perform operations on individual tiles of a SAR image
- 'Low-level' functions that generally perform operations on individual pixel elements

The following algorithms have equivalent low-level and buffer-based functions:

- PSDTL
- PSLTD
- PSPOLSYN
- PSTOTPOW
- PSINTRAT
- PSPHDIFF
- PSCC
- PSPOLDIS
- PSEABA
- PSPEDHT
- PSVANZYL
- PSFREDUR
- PSTOUZIDIS

- PSTOUZIDEC

Contact PCI Geomatics to discover more about our ProPacks and Professional Services customization options.

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For more information, contact

PCI Geomatics
50 West Wilmot Street
Richmond Hill, ON L4B 1M5
Canada

Phone: 1 905 764 0614

Fax: 1 905 764 9604

Email: info@pcigeomatics.com

Web: www.pcigeomatics.com